

UNIVERSITY OF CALIFORNIA  
COLLEGE OF AGRICULTURE  
AGRICULTURAL EXPERIMENT STATION  
BERKELEY, CALIFORNIA

CIRCULAR 115

FEBRUARY, 1914

(Revised November, 1927)

## GRAFTING VINIFERA VINEYARDS

FREDERIC T. BIOLETTI<sup>1</sup>

REVISION BY H. E. JACOB<sup>2</sup>

---

Grafting has two principal uses in grape-growing: (1) to change the variety of fruit in a bearing vineyard; and (2) to establish a new vineyard on phylloxera-resistant roots. Different methods are needed in each case. Only methods for changing the variety in an established vineyard are described here.<sup>3</sup>

*Reasons for Changing Variety.*—When grafting is done to change the variety, the purpose is usually to replace an unprofitable variety with one that has a better market or one more suitable for the soil or climate. Before doing this it is advisable to consider carefully the chances of success.

The cost of grafting and the care of the vineyard until it comes into bearing again is almost as great as the cost of replacing the old vines with new vines of the desired variety. The only advantage of grafting is that the vines bear one or two years sooner. Unless, therefore, the chances seem very great that the first two or three crops of the new kind of grape will pay all the expenses of transforming the vineyard and of the deterioration and shortening of the life of the vineyard, grafting is inadvisable.

Grafting may also be used to change undesirable varieties in mixed blocks. Scattered wine grapes in a vineyard of table grapes or raisin grapes are wasted or are expensive to harvest. These can be best utilized by grafting with the variety of which the block is mainly composed.

Grafting is also a very effective means of rapidly increasing the stock of cuttings for propagating new or rare varieties.

There are cases, therefore, where a change of this kind is advisable. At all events there is always somebody ready to take the risk, and it is advisable to make this risk as small as possible by doing the work properly.

---

<sup>1</sup> Professor of Viticulture and Viticulturist in the Experiment Station.

<sup>2</sup> Junior Viticulturist in the Experiment Station.

<sup>3</sup> Methods suitable for resistant roots can be found described in: Bonnet, L. O. Phylloxera resistant vineyards. California Agr. Exp. Sta. Cir. 288:1-24. 1925.

*Age of Vines.*—*Vinifera* vines may be grafted at any age, but there is seldom anything to be gained by grafting vines less than two or three years old. For younger vines, it is usually cheaper and better to dig up and replant, if a change is necessary. Old vines (twelve years old or over) may be grafted successfully if they are sound and straight below the soil. Such grafted vines, however, are usually short-lived. The large wounds and the great amount of wood which decays often make unhealthy vines. In deep, loose, dry soil the stumps of such vines may be removed entirely and the grafts inserted in the roots. This requires great skill, however, and the percentage of failures is always large. Vines from three to eight years old are the most easily and successfully grafted.

*Choice of Scions.*—Preparation for grafting should be started early by choosing strong, healthy vines of the desired variety, from which to take the cuttings to be used as scions. The failure of grafts is often due to the use of inferior scion wood. The cuttings should be taken from the vines when they are dormant. Any time between one or two weeks after the leaves have fallen and a month before the swelling of the buds, is suitable. However, cuttings taken within a few weeks after the fall of the leaves are the best.

The cuttings should be carefully selected and only good sound canes of medium size and firm texture, well nourished and mature, with well-formed eyes neither too close together nor too far apart, should be used.

*Conservation of Scion Material.*—It is convenient to make the cuttings long enough for two scions, allowing two extra eyes for waste. The length will be from 14 to 24 inches according to the variety and the length of scion used. The cuttings should be made up into bundles of from fifty to one hundred and stored in a cool and moderately dry place. The best way is to put them into pits or trenches under an open shed, and cover them completely with very slightly moist sand. Any shady place where there is no danger of too much moisture getting to the cuttings may be used, such as under a dense tree, the north side of a building, or a cellar.

*Season for Grafting.*—The best time for grafting depends somewhat on the soil and the climate, but usually the latest grafts do the best, provided the scions are completely dormant and otherwise in good condition. If the buds of the scions have started and the bark has loosened, many will fail.

In well drained, sandy soil, the time for successful grafting extends from January to May in most localities, but March for the earlier and April for the later localities are usually the best months. In stiff, wet soils, much greater care is necessary in choosing the time for grafting. The soil should be in such condition that it will pulverize easily, and the heavy rains should be over. Lumpy soil placed about the graft will cause many failures, and a heavy rain which leaves the soil water-logged around the union for several days may kill all the grafts. On the other hand, in the drier and hotter districts, it is often necessary to irrigate the grafts before they start, especially with late

grafting. The soil in contact with the lower part of the scion should never become dry until the union has formed.

It is best whenever possible to wait until the buds begin to swell on the vines to be grafted, and grafting may continue until the shoots are several inches long.

*Methods of Grafting.*—Many methods have been recommended and used for old vines, but only two need be described here: (1) the ordinary cleft graft (fig. 2, *C*, *D*, and *E*) and (2) the groove graft (fig. 2, *F*, *G*, *K*, and *L*). Neither of these methods is difficult and either, if done under proper conditions, should give practically a perfect stand. The cleft graft is the best known in California and is therefore most commonly used, but the groove graft, since it avoids the splitting of the stump and hence offers less opportunity for entrance of decay-causing organisms, should theoretically produce a longer-lived vine.

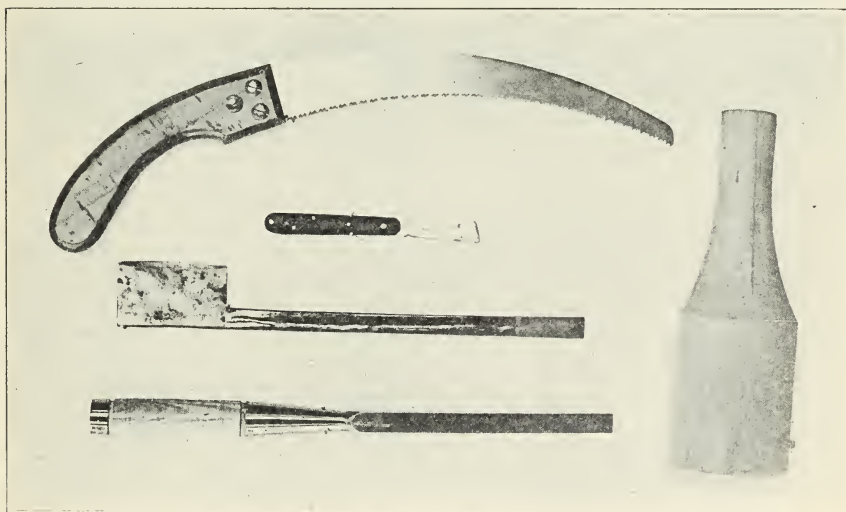


Fig. 1.—Tools for grafting: pruning saw, knife, special grafting tool, chisel, and wooden maul.

*Tools Necessary.*—For cleft grafting, the special tools needed are a curved vine-pruning saw, a grafting or budding knife, a wooden maul, and a strong half-inch mortising chisel. If the vines are very large, that is, over 3 inches in diameter, it is well to have a grafting tool made. Any blacksmith can make a good one from an old horseshoe file. This tool should be 14 inches long. At one end it should be flattened out into a hatchet-shaped blade 3 inches long and 2 inches wide. This blade should be about  $\frac{3}{8}$ -inch thick on the back, gradually tapering to a sharp edge. The other end of the tool should be shaped like a cold chisel about  $\frac{5}{8}$ -inch wide. This cold-chisel edge should be in the same plane as the hatchet edge (see fig. 1) and not at right angles to it as it is sometimes made. For the groove graft only the saw, grafting knife, and a light hammer are needed.

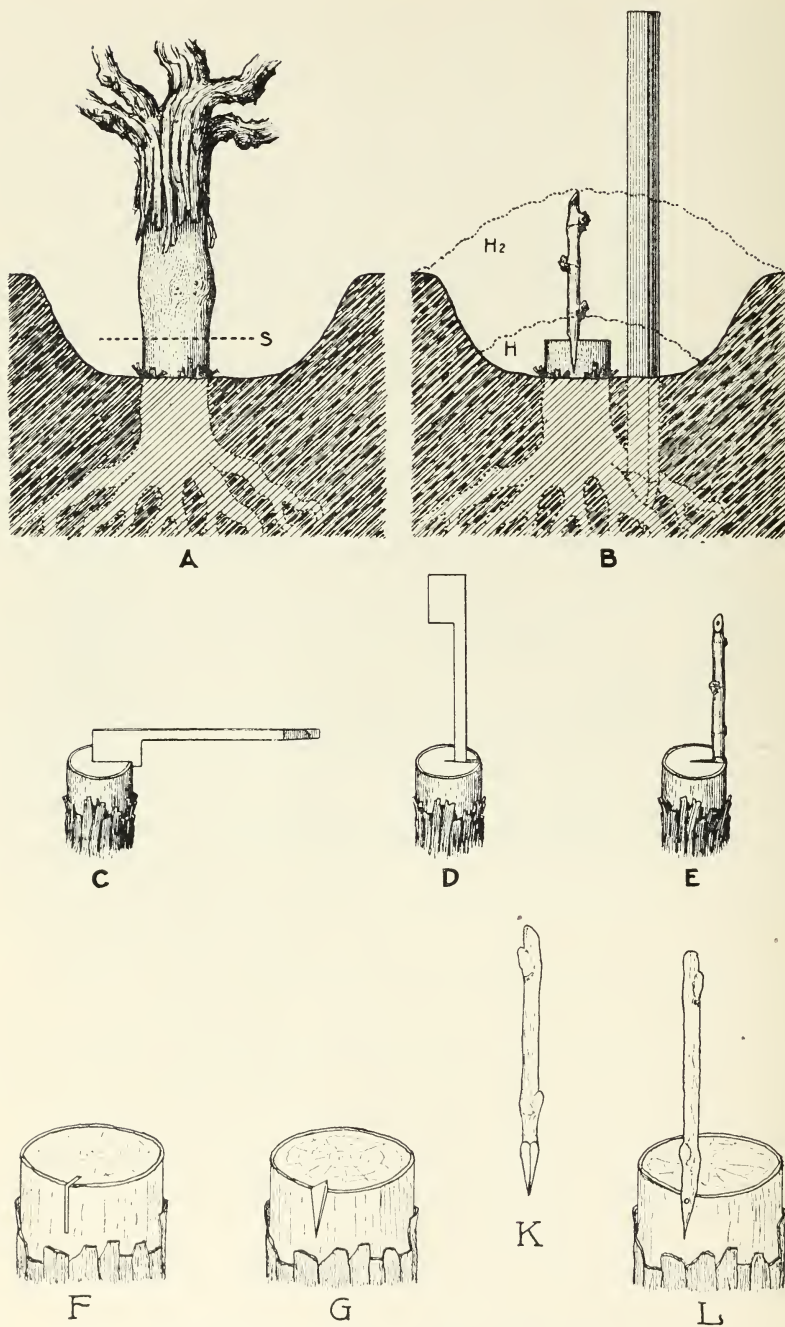


Fig. 2.—Operations of grafting. These operations are explained in the text.



A convenient receptacle for holding the scions is made by cutting a five-gallon kerosene can horizontally through the middle and placing a round stick across the top for a handle. This will hold fifty or more scions. By putting an inch of water in the bottom, they can be kept perfectly fresh.

*Preparation of the Stock.*—The first step is to clear away the earth from around the base of the vine, making a pit about 2 feet in diameter and 3 or 4 inches deeper than the level at which the grafting is to be done. The earth should be well cleaned off the stem of the vine and the rough dry bark removed (*A*, fig. 2). The vine is then ready for decapitation. This should be done by sawing horizontally in such a place that about 2 inches of smooth, straight grain are left at the top (*S*, fig. 2). If the sawing is done at or too near a place where the grain of the wood is crooked or curly, great difficulty will be found by the grafter in making a good fit, particularly with cleft grafting. The amount of sap that will flow out of a vine 2 inches or more in diameter is considerable, sufficient in many cases to kill the graft. This may be avoided by cutting off the vines one or two days before grafting and leaving them exposed in order that the main flow of sap may drain away. This is good practice in all cases where the vines are over  $1\frac{1}{2}$  inches in diameter.

*Preparation of the Scions.*—Proper care of the scions is necessary for the best results. If the cuttings have been made and kept properly, they will show, on being cut, clear greenish-white wood, green inner bark, and firm, dry, light-brown pith. If the wood is streaked or spotted with black, the bark loose or brownish, or the pith black or water-soaked, the cuttings have been injured by too much moisture, or they were poor cuttings to begin with, and should not be used.

Cuttings which are too dry are harder to detect by their appearance. If suspected of being too dry, they may be tested by placing two or three short pieces of two or three buds each in moist sand in a warm room. If in a week the roots do not start nor the buds swell, they are unsafe to use.

Twenty-four hours before they are needed, the cuttings should be taken out of the sand in which they have been stored, and washed to remove all particles of sand, which would dull the grafting knife. They should then stand in fresh water for one or two days, but not more, until used.

*Cleft Graft.*—In making the cleft, a place should be chosen where the bark is smooth, straight, and sound. The cleft should be made by splitting, not by cutting. The edge of the knife or grafting tool should first be placed on the part of the sawed surface where the cleft is to be made, and which has been previously cleaned and smoothed with the grafting knife. With a slight blow of the wooden mallet the edge should be driven about  $\frac{1}{8}$  inch into both wood and bark (*C*, fig. 2). The object of the mark thus made is to insure that the bark and the wood split at the same place. The chisel or the chisel end of the grafting tool should then be placed on the mark sufficiently far from the bark to allow of the insertion of the scion, and driven in an inch

or so, sufficient to open a cleft wide enough to allow the entrance of the scion (*D*, fig. 2). The opening of the cleft is accomplished by pressing the chisel sideways. The scion should then be inserted. When the chisel is released and removed, the tension of the wood will hold the scion firmly in place (*E*, fig. 2).

The cleft should not extend quite across the stock, because if the cleft extends only part way, it will close up more completely and hold the scion more firmly. With small vines, it is impossible to avoid splitting quite across. With very small vines it may be necessary to tie the scion in by putting two or three turns of thin string or raffia around the stock. With very large vines, the pressure is occasionally sufficient to crush the scion. This is obviated by placing a small wedge of wood immediately behind the scion.

The scion is cut in wedge form, a little thicker on the side which comes nearest to the bark. The length of the wedge depends on the character and size of the cleft in the stock. The wedge will usually be long and tapering. It is inserted in such a way that the line between the bark and wood coincide with the corresponding line on the stock. As the bark of the stock is thicker than that of the scion, the outer surface of the scion will be set in slightly from that of the stock. It is not always possible to make the lines correspond exactly, but perfectly satisfactory unions are obtained if these lines are very near together or cross in one or two places.

The cutting of the scion should be done with a very sharp, clean knife, and its insertion in the stock should be immediate, before it has a chance to become dry even on the surface. It is bad practice to prepare the scions beforehand.

If the vines are  $1\frac{1}{2}$  inches in diameter or less, one scion to each vine is sufficient. An attempt to insert more will usually result in having two badly fitting grafts in place of one good one. For larger vines, two scions are preferable whenever they can both be made to fit securely. If both of them grow, the weaker is removed at the next pruning. It will have served a good purpose in helping to heal the grafting wound.

*Groove Graft.*—This differs from the cleft graft in the shape of the scion and the method of inserting it. Instead of being wedge-shaped and inserted in a cleft or split of the stock, the scions are shaped to fit into a V-shaped groove on the side of the stock extending from the top of the stump downward from 1 to  $1\frac{1}{2}$  inches. The width and the depth of the groove at the top should be the same as the diameter of the scion to be used, or slightly less. The groove tapers to a point at the bottom. The scion should be fitted into the groove so that the cambium layer of the scion and of the stock coincide as completely as possible.

The groove in the stock is most conveniently formed by first making a shallow, straight saw cut as long and as deep as the groove is to be (*F*, fig. 2). Then by means of a sharp knife the groove is widened at the top and tapered to a point at the bottom (*G*, fig. 2). When finished, the cut surface should be smooth and straight. If it is rough and irregular, a good fit with the scion cannot be secured.

The scion should be shaped so that the cambiums of the stock and scion coincide when it is placed in the groove. The angle that the cuts of the scion make with one another should be slightly more obtuse than the angle of the groove. Thus, when the scion is placed on the stock, the contact will be firm at the line of the bark, which will insure close contact of the cambiums. Figure 2, *K*, shows a scion properly shaped to fit the groove in the stock (fig. 2, *G*).

After inserting the scion in the groove, it should be held firmly in place until the tissues grow together. This can be accomplished most easily by nailing it with one or two 1-inch 19-gauge, flat-headed wire nails (*L*, fig. 2).

*Length of the Scion.*—It is usual to use scions of two buds, but there is often an advantage in having them longer. Three and even more buds have been used with advantage on large vines. With only two buds on such vines the growth is often so rapid and so large as to be almost unmanageable. With several buds the growth is divided between more shoots and they are less likely to grow so large as to be troublesome.

*Covering the Scion.*—As soon as the scion is in place, all cut surfaces of stock and scion should be carefully covered with a couple of inches of moist, well-pulverized soil (*H*, fig. 2), and a stake driven in such a position that it will support the first growth of the graft. The complete filling of the hole may be deferred for a few hours, but not long enough to run any risk of having the scion become even slightly dry; in extremely hot, dry weather the hole should be filled immediately. No wax, clay, or similar material is needed unless the cleft is large. There is nothing better to put around the union than moist, loose soil. This gives the conditions of moisture and aeration most favorable to the uniting of the tissues. With a cleft graft it is a good practice to cover the cleft in the stock with a little clay, a leaf, or anything that will exclude the soil, but unless the cleft is large, this is not necessary. It is never necessary with the groove graft. The filling of the hole with soil should be complete; the whole scion may be covered up unless the soil has a tendency to bake. When finished, each graft will be in the middle of a wide mound of soil (*H*<sub>2</sub>, fig. 2). Narrow mounds may become too dry.

*After-Treatment of the Grafts.*—The proper management of the grafts during the first growing season is as important as the grafting itself.

The mounds should not be disturbed by hoe or cultivator until the unions are well formed. If the scions are completely covered and the mounds form a hard crust, this crust should be carefully broken with the fingers.

*Suckering.*—Many large, vigorous shoots will come up from the old stock. If these are left too long, they will choke or dwarf the graft. If they are removed too soon, many good grafts will be killed by injuring the unions. Judgment and careful work are therefore needed in suckering. When the grafts have started to grow vigorously, so that the shoots can be tied to the stake, it is safe to begin suckering.

At this time the suckers can usually be pulled up by the hand in bunches, without removing any soil. Unless it is certain that the suckers are not entangled with the scion, some soil must be carefully removed until it is possible to see how to detach the suckers without disturbing the union.

If grafts are slow in starting, and the suckers vigorous, it is necessary to sucker before the scion has grown much. This can be done safely if care is used.

*Tying up the Shoots.*—When the union is complete, the growth of the grafts on large vines is generally very rapid. A growth of 2 or 3 inches a day is common, and many canes grow 10 to 15 feet by the end of the season. Unless this vigorous growth is properly managed, not only are its benefits lost, but it also gives great trouble the following year and makes it impossible to obtain a properly shaped, healthy vine. If the canes are left to themselves they will often grow flat on the ground. As they may be 1½ inches thick or more by the end of the season, the attempt to raise them up the next year will result in tearing many of the finest grafts out of the stock, and the rest will make ill-shaped vines, weakened by numerous large wounds.

The shoots should, therefore, be tied loosely to the stake with a piece of string or thin rope as soon as they are long enough. If too many shoots start, they should be thinned. This thinning should be done early in order to throw all the available strength and growth into shoots left. One shoot to each bud is enough on strong vines, and one shoot to a graft on weak or small vines.

The management of the shoots from this time is exactly the same as for exceptionally vigorous ungrafted vines. A well placed vigorous shoot is selected and tied carefully to the stake until it is a little higher than the desired head of the vine. It is then cut back to a point two or three inches above the point of heading. For unilateral cordon vines, the shoot is trained along the wire and this cutting back is not done until the shoot reaches the extreme length of the cordon. For bilateral cordons the cutting back is done so that the point where the trunk should divide into its two branches is between the two highest buds left.<sup>4</sup> When this cutting back of the selected shoot is done all other long or vigorous shoots should be cut back at the same time. The laterals which start less than 8 or 10 inches from the base of the main shoot should be pinched off when small, but all laterals above that should be allowed to grow. The new vine is thus completely formed the first season, the main shoot forming the trunk of the vine and the laterals the branches. Such a vine may produce almost a full crop the following year.

*Cost of Grafting.*—The cost of grafting over an old vineyard properly will in all cases be heavy, and will seldom be less than \$35 per 1000 vines above the ordinary cost of cultivation, and without reckoning the cost of stakes and the loss of crop. With large vines the cost may considerably exceed this.

<sup>4</sup> For fuller directions see Bioletti, Frederic T., and H. E. Jacob. Head, cane, and cordon pruning of vines. California Agr. Exp. Sta. Cir. 277:1-32. 1924.